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<b>Title</b>	Managing legacy soil phosphorus in grassland soils for agricultural productivity and environmental quality: a review
<b>Authors(s)</b>	Murphy, Paul; Sims, T.J.; McDowell, R.; et al.
<b>Publication date</b>	2013-09-09
<b>Conference details</b>	The 7th International Phosphorus Workshop, Uppsala, Sweden, 9-13 September 2013
<b>Link to online version</b>	<a href="https://www.slu.se/institutioner/vatten-miljo/aktuellt/2013/9/7th-international-phosphorus-workshop">https://www.slu.se/institutioner/vatten-miljo/aktuellt/2013/9/7th-international-phosphorus-workshop</a>
<b>Item record/more information</b>	<a href="http://hdl.handle.net/10197/9651">http://hdl.handle.net/10197/9651</a>

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# MANAGING LEGACY SOIL PHOSPHORUS IN GRASSLAND SOILS FOR AGRICULTURAL PRODUCTIVITY AND ENVIRONMENTAL QUALITY: A REVIEW

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## Abstract

Phosphorus (P) is a lithophile element that tends to accumulate in the solid phase at the Earth's surface and has a low water solubility. As P is a limiting nutrient for plant growth in most terrestrial systems, P in fertilizers has been a major factor underpinning global agricultural production in the 20<sup>th</sup> and early 21<sup>st</sup> centuries, including that from grassland. However, P is a costly farm input and it is also a finite mineral resource. Best agronomic practice is to maintain soil P levels at optimum over the medium-to-long term by managing P application and offtake. However, in some cases, soil P levels have been built up in excess of agronomic optimum due to P application driven by organic "waste disposal" or with the intention of building up a "bank" of soil P for future use. This has been associated with P losses to surface waters and impacts on water quality. Legislation, policy and best management practice advice in many countries has attempted to affect these legacy high P soils through a range of measures. In Ireland, for example, the Good Agricultural Practice measures, introduced in 2006 under the Irish Nitrates Action Plan, attempt to impose P deficits on soils with high P. National data shows that P fertilizer use declined by 55% on grassland soils between 2003 and 2008 and would suggest that soils with high soil P levels dropped from 30% in 2007 to 22% in 2011. This paper presents a review of the international literature on legacy excessive P in grassland soils, management practices and policy measures to manage them, and changes in soil P in response to such measures. Consideration is given to both agronomic and environmental concerns. There are a number of factors in grassland production systems, and particularly dairy production systems based on grazed grass, that differ from other agricultural production systems. For example, offtakes are typically lower than in tillage and the recycling of P, either by animal deposition or spreading of manures, gives less control to the farmer. Important questions addressed include: how quickly do grassland soil P levels decline under situations of negative P balance?; what fractions of P control soil P decline?; what grassland management practices are important in determining where and how fast soil P levels decline?; and what scale is appropriate to implement practice change and monitor effects?